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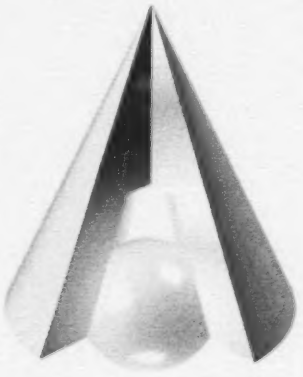
Intergenerational Income Transmission: New Evidence from Canada



by Wen-Hao Chen, Yuri Ostrovsky and Patrizio Piraino

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[r] revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
[E] use with caution
F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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Intergenerational Income Transmission: New Evidence from Canada

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Abstract

This paper uses an updated version of a unique administrative dataset for Canada to test the impact of lifecycle earnings variation and errors-in-variables bias on estimates of the intergenerational income elasticity. The study finds higher levels of intergenerational earnings and income persistence compared with previous studies. Lifecycle bias in early estimates explains nearly two-thirds of the discrepancy, while errors-in-variables bias contributes to the remaining difference. The study shows that these biases have a smaller impact on daughters than on sons. The improved dataset is also used to re-examine nonlinear patterns in the intergenerational transmission of income in Canada. The findings suggest that limited mobility at the top of the distribution accounts for much of the average income persistence across generations, while mobility is found to be significantly higher among children born to low-income fathers. A comparison of the findings of this study with the international evidence reveals that nonlinear patterns in Canada are somewhat different from those observed in the United States and resemble the patterns found in Northern Europe.

JEL classification: J62, D31, D63

Keywords: earnings inequality, intergenerational mobility

Executive summary

Comparative studies of intergenerational earnings and income mobility largely rank Canada as one of the most mobile countries among advanced economies, such as Denmark, Finland and Norway. The assertion that Canada is a highly mobile society is drawn from intergenerational income elasticity estimates reported in Corak and Heisz (1999). Corak and Heisz used data from the earlier version of the Intergenerational Income Database (IID), which tracked the income of Canadian youth only into their early thirties. Recent theoretical literature, however, suggests that the relationship between childrens' and parents' lifetime income may not be accurately estimated when children's income is not observed from their mid-careers— known as **lifecycle bias**.

The present study addresses this concern by re-examining the extent of intergenerational earnings and income mobility in Canada using the updated version of the IID, which tracks children well into their mid-forties, when mid-career income is observed. This information is essential for intergenerational analysis, as the literature shows that bias arising from lifecycle variation can be greatly mitigated by comparing fathers' and offspring's earnings near their mid-careers. Moreover, this paper also examines whether intergenerational mobility differs across the population. With nearly 250,000 observations, the study can differentiate the degree of intergenerational transmission across the full spectrum of the income distribution.

The empirical analysis in this study is based on Statistics Canada's IID, which was constructed from various tax records to link together children and their parents. The IID consists of youth aged 16 to 19 in 1982 whose tax records are linked to the tax records of their parents by means of the parents' and the children's Social Insurance Numbers and information from Statistics Canada's T1 Family File. The data provide more than 20 years of income history for both parents (1978 to 1999) and children (1986 to 2008) that allows for comparison of the income of children and parents when they were at the main stage of the lifecycle.

The results from the analysis suggest that Canada is still a mobile society, but not to the same extent as previously thought. The new estimate of the father–son earnings elasticity is about 0.32, which is noticeably higher than the values previously reported in the literature (which have been in the neighbourhood of 0.2): lifecycle bias alone explains about two-thirds of the discrepancy between the early estimates and the new result. The extent of intergenerational persistence tends to be greater when market income (i.e., the sum of earnings, self-employment income and asset income) is measured. This suggests that other mechanisms, such as transmission of jobs or entrepreneurial skills, may also be at work. Interestingly, the analysis also shows that the father–daughter elasticity is much less sensitive to these biases. Moreover, the paper documents a clear pattern of nonlinearity in the intergenerational transmission of earnings and income in Canada. In particular, the path to the top of the distribution appears to be quite challenging for sons born to low-income fathers. On the other hand, these same sons appear to have significant chances of moving into the middle class. Social institutions may help explain the latter findings. Finally, this paper demonstrates that the patterns of nonlinearity can be significantly misread when the lifecycle bias is not adequately addressed, especially over the upper part of the distribution.

1 Introduction

Comparative studies of intergenerational earnings and income mobility largely regard Canada as one of the most mobile countries among advanced economies (Björklund and Jäntti 2010; Corak 2013; Solon 2002). A popular chart—known as the "Great Gatsby Curve"— is often used to depict the relationship between income inequality and social mobility, and depicts Canada as one of the countries with the highest mobility, at levels similar to those observed for Denmark, Finland and Norway.[1] The assertion that Canada is a highly mobile society is drawn primarily from intergenerational income elasticity (IGE) estimates reported in Corak and Heisz (1999), as well as in Fortin and Lefebvre (1998). While these are careful studies that offer the best estimates of the IGE based on the data available at the time of their writing, recent literature suggests that such estimates may be subject to bias due, in particular, to lifecycle variation (Mazumder 2005; Haider and Solon 2006; Böhlmark and Lindquist 2006).

In the absence of data on lifetime earnings, IGE estimates may be affected by measurement error on both sides of the equation. Lifecycle bias may arise in a father–child analysis when a child's permanent earnings, proxied by yearly or short-run average earnings, are observed at a time of the child's working career when earnings do not closely correspond to their lifetime values. Haider and Solon (2006) showed that this type of bias usually results in lower estimates of the IGE when earnings from the early (or too late) stages of the working careers are used. Their finding is consistent with reviews of the literature showing that the smallest IGE estimates are most often found in studies where sons' earnings are observed at younger ages (Solon 1999). This is also evident in Corak et al. (2014) who find that the Canadian IGE estimate increases from 0.22 to 0.26 when sons' earnings are observed at age 35 rather than 30, suggesting that lifecycle effects should not be ignored in Canada as well.[2]

In addition to lifecycle bias, the IGE estimates may also be affected by the classical errors-in-variables bias (right-hand-side measurement error), which occurs when fathers' lifetime earnings are not adequately measured. Corak and Heisz (1999), for instance, addressed this problem by using a five-year average instead of single-year earnings to approximate fathers' lifetime earnings. While such practice reduces the errors-in-variables bias, it may not eliminate it entirely if the number of years used in the calculation of the averages is insufficient. Mazumder (2005) showed that even estimates based on five-year average earnings are still subject to a significant errors-in-variable bias.

The primary objective of this study is thus to re-examine the extent of intergenerational earnings and income mobility in Canada in light of the estimation issues raised in the literature. Using longitudinal earnings data from a significantly higher number of years compared with previous research, the study highlights the sensitivity of IGE estimates to lifecycle and errors-in-variables bias. Importantly, the paper also revisits the issue of nonlinearity in the intergenerational transmission of earnings. Improved measures of fathers' and childrens' permanent earnings may have a different impact on the estimated intergenerational persistence at different parts of the distribution. Both polynomial and quantile regression specifications are employed to investigate

1. See (http://www.whitehouse.gov/sites/default/files/six_challenges_for_the_statistical_community.pdf). The term, "Great Gatsby Curve" was first introduced in 2012 by Alan Krueger, Chairman of the U.S. Council of Economic Advisers, who used data from the work of Miles Corak.
2. The focus of the analysis in Corak et al. (2014) is not primarily on the IGE. They use an older version of the intergenerational tax files used in this paper, which had significant shorter earnings histories compared to the updated version used here.

this possibility. With nearly 250,000 observations, it is possible to examine differences in the degree of intergenerational mobility across the full spectrum of the income distribution.

The empirical analysis is based on an augmented version of the Intergenerational Income Database (IID), a high-quality dataset linking administrative records of parents and children in Canada. The data make it possible to introduce two essential novel elements compared with the earlier literature. First, the updated IID maintains the exceptionally large sample size of earlier versions, while offering a significantly longer panel of tax records for children, who are now observed from their late teen years well into their mid-forties. This information is essential for testing the impact of lifecycle bias on the IGE estimates, as the literature shows that this bias can be greatly mitigated by comparing fathers' with an offspring's earnings near their mid-careers (Grawe 2006; Haider and Solon 2006; Gouskova, Chiteji and Stafford 2010). Second, instead of being averaged over an arbitrarily defined calendar time period, income in this study is averaged over a specified age range. With up to 22 years of valid data, a father's lifetime income is approximated by averaging the income he received over the ages of 35 to 55. This approach should significantly reduce (if not eliminate) the attenuation bias arising from measurement error in fathers' permanent income.

The results from the analysis carried out in this study suggest that the extent of intergenerational earnings and income mobility in Canada was overestimated in the early studies. The new estimate of the father–son earnings elasticity is about 0.32, a result that is noticeably higher than the values previously reported in the literature (in the neighbourhood of 0.2). Failing to account for lifecycle bias explains about two-thirds of the difference between the current and previous estimates, while errors-in-variables bias contributes to another one-third of the discrepancy. Interestingly, the analysis performed in this study also shows that the father–daughter elasticity is much less sensitive to these biases. Finally, the study finds that the impact of such biases is more pronounced at the top of the income distribution, and documents a clear pattern of nonlinearity in the intergenerational transmission of earnings and income in Canada. In particular, the path to the top of the distribution appears to be quite challenging for sons born to low-income fathers. On the other hand, these same sons appear to have significant chances of moving into the middle class.

The remainder of the paper is organized as follows. Section 2 describes the data and the calculation of permanent earnings and income. Section 3 examines the sources of bias arising from imperfect measures of lifetime income and how these may affect estimates of the IGE. Section 4 presents the new estimates of intergenerational earnings and income mobility in Canada for both father–son and father–daughter pairs. Section 5 addresses the issue of nonlinearity, while Section 6 concludes.

2 Data and calculation of lifetime income

The empirical analysis in this study is based on matched parent–offspring tax records from an updated version of the IID file. A detailed description of the original IID file, which covered the period from 1978 to 1995, can be found in Corak and Heisz (1999). In essence, the IID file consists of three sub-samples of children aged 16 to 19—in (i) 1982, (ii) 1984 and (iii) 1986—whose tax records are linked to the tax records of their parents by means of the parents' and the childrens' Social Insurance Numbers and information from Statistics Canada's T1 Family File (T1FF). To improve coverage, child–parent pairs are drawn from the T1FF over all years from 1982 to 1986; where such links are available in multiple years, the earliest ones are retained. Once the child–parent link is established, it is possible to track children's and parents' annual earnings from 1978

to the latest available year (1995 in the original IID and 2008 in the updated file) by means of annual tax files (T1) and individuals' unique longitudinal identifiers based on their SINs.

One of the limitations of the original version of the IID was the relatively short number of adult years over which sons and daughters could be observed. For instance, even the oldest cohort of children—those born during the period from 1963 and 1966—could be observed only up to 29 to 32 years of age (in 1995). Observations on the other two cohorts of children were limited to even younger ages. The recently updated version of the IID has the same structure as the original file—same three cohorts of children—but it extends the sample period up to 2008. Hence, the children from the 1963-to-1966 cohort can now be observed up to 42 to 45 years of age. The child cohorts born during the periods from 1965 to 1968 and from 1967 to 1970 can now be observed up to 40 to 43 years of age and 38 to 41 of age, respectively. The analysis in this study focuses mainly on the 1963-to-1966 cohort of children and their linked fathers.

It should be mentioned that not all existing father–child pairs can be identified in the IID. First, a generational link cannot be established if a child, still living with his/her parents, did not file a tax return in any year from 1982 to 1986. Second, generational links cannot be established for children linked to families that had no records of fathers from 1982 to 1986. Finally, father–child links cannot be established for children whose records could not be linked to any family.[3] Along with Solon (1992) and Corak and Heisz (1999), this study uses only the oldest sons (daughters) when more than one son (daughter) is matched to the same father.

The analysis looks at three different income measures: earnings, market income and total income. Earnings are measured as a sum of wages from T4 slips issued by employers and other employment income, including tips, gratuities and directors' fees. Market income further includes rental income, self-employment income as well as asset income.[4] Total income refers to market income plus all government transfers, such as unemployment insurance benefits and pension benefits, but excluding taxes.[5] All monetary amounts are expressed in constant 2010 dollars.

2.1 An improved measure of lifetime earnings and income for fathers

It is well recognized in the literature that the use of current or single-year income as a proxy for permanent income can result in significant errors-in-variables biases in the estimation of the IGE (Solon 1999). A common remedy is to use multi-year averages to reduce the transitory component of income. However, in the absence of a full history of lifetime data, the number of years over which researchers can observe income is rather limited—usually three to five years. While the literature seems to agree that multi-year averages are better measures of permanent income than single-year records, there has been relatively little discussion on the exact number of years required for the computation of the averages. Is taking five-year averages sufficient to approximate for lifetime income? Using a unique (but rather small) set of linked survey and administrative data, Mazumder (2005) concluded that short-term proxies for fathers' permanent

3. As noted in Corak and Piraino (2011), the algorithm used to create the data leads to an under-representation of children from lower-income backgrounds and from the major metropolitan areas (Montréal, Toronto and Vancouver). Studies that have investigated the underreporting (Corak and Heisz 1999; Oreopoulos 2003; and Oreopoulos, Page and Stevens 2008) found little evidence of bias in their analytical results. The empirical analysis below makes use of census-based weights created to account for this underreporting.
4. Self-employment income includes five broad categories: business income, commission income, professional income, farming income and fishing income. Asset income covers dividends and investment/interest income.
5. See the *Intergenerational Income Data Reference Manual* (Statistics Canada 2010) for a detailed list of income sources.

income may still be susceptible to bias as the variance of the transitory component of income varies considerably by age.

Moreover, the age at which fathers' income is averaged is sometimes overlooked in the literature. Corak and Heisz (1999), for instance, calculated fathers' permanent income by averaging their annual income over the period from 1978 to 1982. However, some fathers in the sample may have been too young or too old during the observed period and, therefore, the averages may not have properly captured their permanent income. Appendix Table 1 displays the age distribution of fathers in the IID. Indeed, nearly one-quarter of fathers in the sample were, arguably, either too young or too old from 1978 and 1982: about 5.3% of the fathers were aged 34 and under at the beginning of 1978, and nearly 18% of fathers were aged 56 or over by the end of 1982. As expected, the earnings of these fathers were significantly lower compared with those of their prime-age counterparts. Even within the prime-age group, there was some degree of variation: the mean earnings tended to be higher among fathers who were aged from 41 to 45 during the period from 1978 to 1982.

To improve the measure of fathers' lifetime income, their annual income at the age of 35 to 55 was averaged, conditional on their having had positive values ($500 and over in constant 2010 dollars) in at least 10 of these 21 years. The age restriction ensures that the income averages for fathers in the sample are calculated at a similar stage of their lifecycles and therefore are less affected by the larger transitory components typical of the early and late stages of individuals' working careers. Restricting the sample to fathers with 10 or more (non-successive) years of positive income further reduces variation driven by few high- or low-income years within the prime age. Note that, for each father in the IID, earnings and income data were available from 1978 to 1999. This implies that different cohorts of fathers will have different years over which their earnings can be averaged (see Appendix Table 2 for an illustration).[6] In order to have at least 10 positive annual records that satisfy both the age (35 to 55) and the calendar time (1978 to 1999) restrictions, only fathers born in the years from 1932 to 1955 could be included.[7] It is important to point out that the proposed measure is regarded as an improved proxy for lifetime income, rather than its "true" measure. The final sample consisted of 356,321 fathers (with positive lifetime earnings) that can be matched to childrens' records.[8] Of these fathers, 56.4% were from the 1932-to-1938 cohorts, and 40.2% were from the 1939-to-1945 cohorts. Only 3.4% were born during the period from 1946 to 1955.

6. For instance, the incomes of a father born in 1943 can be averaged from 1978 to 1998 (when he was aged 35 to 55). A younger (older) father, such one born in 1950 (1935), was aged 35 to 55 in 1985-to-2005 (1970-to-1990). In this case, only up to 15 (13) years of data will be used to compute the average, provided that positive annual earnings are observed in at least 10 years.
7. The oldest fathers included in the analytical sample are those born in 1932, as they were aged 46 in 1978 (the first earnings year available), and they will be in the sample only if they received positive earnings in each year at the ages of 46 to 55. Similarly, the youngest fathers that could be included are those born in 1955, as they were aged 44 in 1999 (the last earnings year available), and they will be in the sample only if they received positive earnings in each year at the ages of 35 to 44.
8. In the case of market income and total income, the number of included fathers is much higher, at 489,410 and 502,580, respectively.

3 Empirical testing for lifecycle bias and errors-in-variables bias

Using U.S. data, Haider and Solon (2006) showed that the bias arising from lifecycle variation could be greatly reduced if children' earnings were measured at their mid-careers. However, determining the age that minimizes the lifecycle bias is an empirical task. It is important to note for the purposes of this study that such age may be country-specific. In this section, Haider and Solon's generalized errors-in-variables model is applied to IID data. It should be emphasized that the purpose of this exercise was not to formally examine the association between annual and lifetime earnings, as was done by Haider and Solon (2006), since this would require full lifelong-earnings histories, which were not available in the IID.[9] In addition, the analysis in this study was conditional on the sample of men who were intergenerationally linked at a certain point in their lives, which may not be comparable to the broader samples used in studies that have focused mainly on lifecycle earnings variation. As a consequence, this section is intended solely to illustrate the bias in IGE estimates, when the lifetime income of fathers and offspring cannot be adequately measured.

Following the literature standards, a simple model describing the relationship between fathers' and children's incomes can be written as:

$$Y_i^s = \alpha + \beta Y_i^f + \varepsilon_i \tag{1}$$

where $Y_i^s (Y_i^f)$ is the log of child's (father's) lifetime income, ε_i is a random error uncorrelated with Y_i^f, and β captures the IGE. Since permanent income is usually not available for either fathers or children, the attempt to measure this variable by yearly data or even multi-year averages—which is common in the literature—could result in biased estimates of the IGE as a result of measurement errors on both sides of the equation. To illustrate this, the analysis follows Haider and Solon (2006) and defines the left-hand-side income measure (children's earnings in this study) as:

$$Y_{it} = \lambda_t Y_i + u_{it}, \tag{2}$$

where Y_i is the lifetime income proxied by Y_{it} (annual earnings at age t), u_{it} is a random disturbance uncorrelated with Y_i and ε_i, and λ_t is the slope coefficient in the so-called "forward regression" of Y_{it} on Y_i. Suppose one wishes to estimate (1). Substituting (2) into (1) gives

$$Y_{it} = a + \lambda_t \beta Y_i^f + (\lambda \varepsilon_i + u_{it}). \tag{3}$$

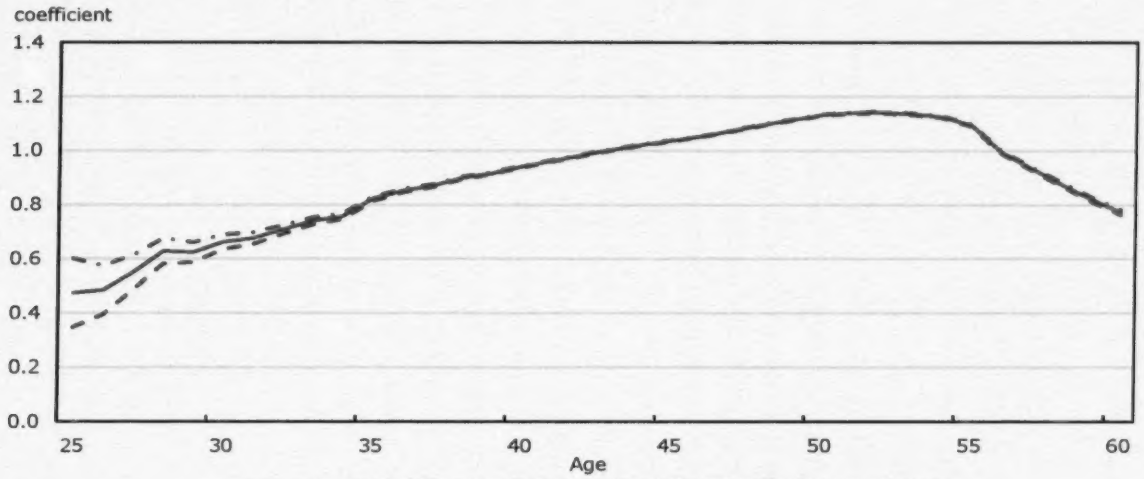
Therefore, $\lambda_t \beta$ (instead of β) is the probability limit of the estimated coefficient on Y_i^f. As a result, the ordinary least squares (OLS) estimator of (1) is consistent only when $\lambda_t = 1$. A lifecycle bias thus arises when $\lambda_t \neq 1$, and this result may vary with the age at which incomes are observed. Haider and Solon (2006) demonstrated this for the United States. λ_t profiles vary

9. A related Canadian study is Baker and Solon (2003), who used a representative sample from tax files to examine lifecycle patterns in earnings dynamics. They show that the variance of transitory log-earnings varies significantly over the lifecycle.

notably across the lifecycle: the profile begins at 0.24 at age 19, rises to about 1 at age 32, and declines towards the end of the working career.

Chart 1 presents estimates of λ_t using the IID data described above. They are slope coefficients in the forward regression of log annual earnings, at age t, on log lifetime earnings (Equation 2). As explained above, lifetime earnings are calculated by taking average earnings over the ages of 35 to 55 (conditional on positive values for at least 10 years). This proxy may be considered an upper-bound estimate of lifetime earnings since it excludes low-earnings years (i.e., early and late parts of the lifecycle). Nonetheless, to the extent that the prime-age earnings are more representative of the lifetime values (Haider and Solon 2006; Böhlmark and Lindquist 2006), the coefficients from the forward regressions can provide some guidance on the possible presence of lifecycle bias in previous estimates of the IGE in Canada. The results in Chart 1 indicate that λ_t does not equal 1 throughout the lifecycle. This value begins at 0.47 at age 25, increases gradually and reaches unity in the early forties. It continues to increase to about 1.14 at age 52, and falls back to below 1 after age 56. An important implication of Chart 1 is that the estimates of the IGE could be significantly underestimated when sons' earnings are observed at younger ages. This finding appears to justify the intention to revisit the previous Canadian estimates. Chart 1 also suggests that any bias arising from lifecycle variation may be mitigated when sons' earnings are measured somewhere around the late thirties or early forties (taking into account the fact that the permanent income measure in this study may overestimate lifetime earnings).

Chart 1
Estimate of λ_t (lifecycle bias)



Notes: Sample includes those with positive lifetime earnings. For each individual in the sample, lifetime earnings are calculated by averaging one's income at age 35 to 55, conditional on having positive income ($500 and over) in at least 10 years. All earnings are Consumer Price Index adjusted in 2010 constant dollars.
Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

Haider and Solon (2006) also addressed the right-hand-side measurement error. The unobserved regressor, Y_i (fathers' lifetime earnings, in this case), is proxied by annual earnings at age t, Y_{it}:

$$Y_i = \theta_t Y_{it} + v_{it}. \tag{4}$$

Equation (4) is called the "reverse regression" of Y_i on Y_{it}, and the probability limit of the estimated slope coefficient is

$$\text{plim}\,\hat{\beta} = \frac{\text{cov}\left(Y_{it}^f, Y_i^s\right)}{\text{var}\left(Y_{it}^f\right)} = \theta_t \beta, \tag{5}$$

where

$$\theta_t = \frac{\text{cov}\left(Y_{it}^f, Y_i^f\right)}{\text{var}\left(Y_{it}^f\right)} = \frac{\lambda_t \text{var}\left(Y_i^f\right)}{\lambda_t^2 \text{var}\left(Y_i^f\right) + \text{var}\left(v_{it}\right)}. \tag{6}$$

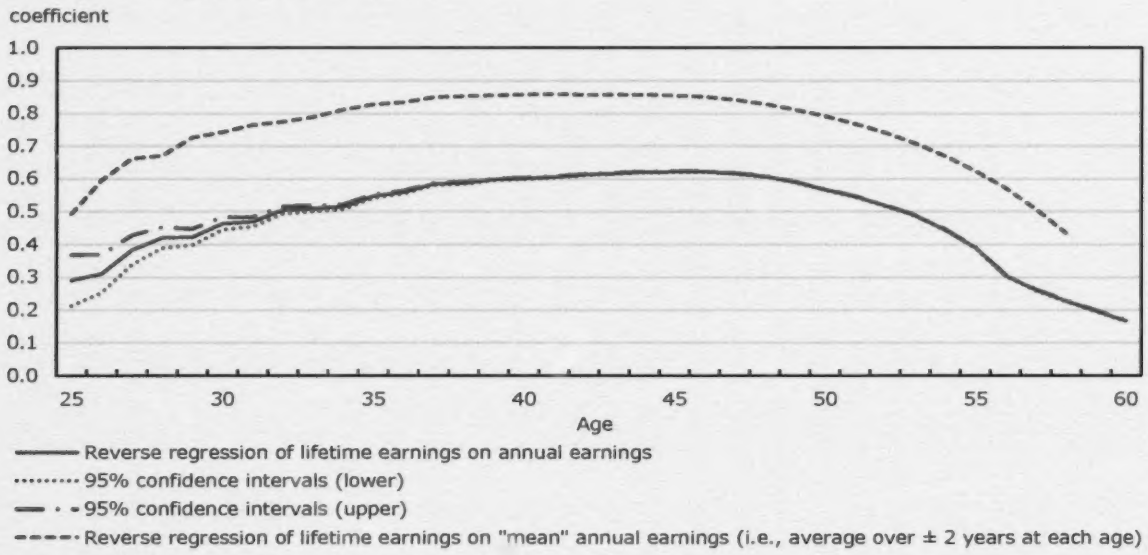
When $\lambda_t = 1$, θ_t is simply the textbook case of attenuation bias. However, θ_t will also depend on the value of λ_t. Haider and Solon (2006) argued that, in rare cases, θ_t can turn out to be an amplification, rather than attenuation, bias.

The measure of lifetime earnings is used to estimate the trajectories of θ_t for Canadian men (Chart 2). As expected, using annual earnings to approximate lifetime values on the right-hand side of the regression results in a significant attenuation bias (solid line). The bias is especially pronounced $\left(\theta_t = 0.25\right)$ when current earnings are observed early or late in the lifecycle, and remains large (about 0.60) when earnings are measured at the mid-career years. These findings are in line with Björklund (1993) and Böhlmark and Lindquist (2006) for Sweden, as well as with Haider and Solon (2006) for the United States.

In practice, researchers often use multi-year averages instead of yearly earnings as a proxy for lifetime earnings. To what extent do such practices reduce the errors-in-variables bias? To answer this question, the reverse regressions are re-estimated with current annual earnings replaced by *mean* annual earnings within a five-year window, centered at any given age.[10] Chart 2 (dashed line) reveals that the attenuation bias can be significantly mitigated when, instead of annual earnings, five-year averages are used to proxy lifetime earnings. The estimated θ_t can be as high as 0.85 when mid-career multi-year earnings averages are used. Chart 2 also supports Mazumder (2005), who argued that even estimates based on five-year averages are still subject to non-negligible errors-in-variables bias. All in all, results from both Charts 1 and 2 seem to suggest that the Canadian IGE may have been underestimated in previous studies.

10. For instance, mean earnings at age 30 will be a five-year average over the ages from 28 to 32. Similarly, mean earnings at age 55 are averages over the ages of 53 to 57.

Chart 2
Estimate of θ_t (attenuation bias)



Notes: Sample includes those with positive lifetime earnings. For each individual in the sample, lifetime earnings are calculated by averaging one's income at age 35 to 55, conditional on having positive income ($500 and over) in at least 10 years. All earnings are Consumer Price Index adjusted in 2010 constant dollars.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

3.1 International comparison of bias profiles

In this subsection, the estimated Canadian bias profiles are compared with those of other countries. The comparison may shed some light on the sources of cross-country differences in the intergenerational transmission of earnings. A few studies have investigated the association between current and lifetime income. Haider and Solon (2006) were the first to offer empirical estimates of λ_t and θ_t based on nearly career-long earnings histories from a U.S. panel. Two other papers known to the authors have been able to replicate the approach followed by Haider and Solon for other countries: these are Böhlmark and Lindquist (2006) for Sweden, and Brenner (2010) for Germany, using data from Swedish tax records and the German Socio-Economic Panel, respectively.[11]

The estimates of λ_t and θ_t from these studies are shown in Panel A and Panel B of Chart 3, respectively. To improve comparability, Canadian men are restricted to those born during the period from 1939 to 1945—a cohort with an age range similar to that of the German and Swedish cohorts, but still about a decade younger than the American cohort. The Canadian profile is shorter because only up to 21 years of earnings data are available in the IID. In general, with respect to the estimated λ_t, all four studies show that the textbook scenario of $\lambda_t = 1$ throughout

11. Nybom and Stuhler (2011) also offered estimates of bias profiles for Sweden using the same data as those used by Böhlmark and Lindquist (2006).

the lifecycle does not apply. As a consequence, using annual earnings from early career stage to proxy for lifetime earnings, as the dependent variable, would lead to an attenuation bias.

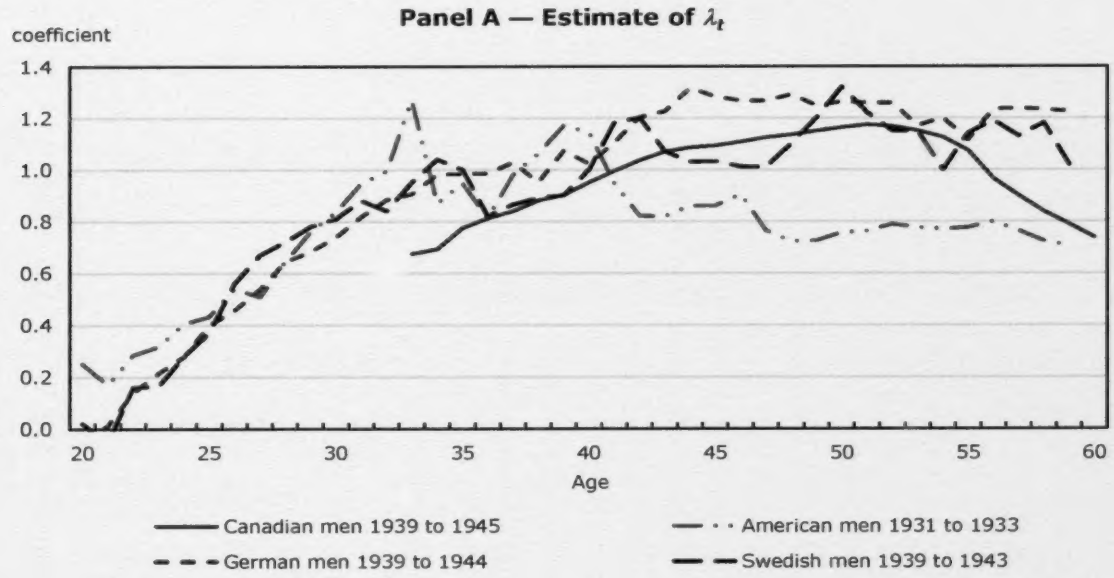
There is also a similarity in terms of where (or at what age) the lifecycle bias is minimized. The estimate of λ_t seems to approach 1 at the age of 40 for Canadian men, but does so at a somewhat younger age—at around mid-thirties—for those of the other three countries. This may be due to the fact that the measure of lifetime earnings for Canada in this study is overestimated by definition (i.e., because individuals' earnings are averaged over their prime age). However, 95% confidence intervals around these profiles do overlap over the mid-career, at age 40 to 41. After 41, the bias profiles for each country become more distinct. For the United States, the lifetime earnings are underestimated from the mid-career on, while the opposite seems to be the case for Germany, where λ_t continues to grow until the age of 44 and remains above unity throughout the rest of the career. The Canadian and Swedish profiles are somewhat similar in the sense that the estimated λ_t in both countries peaks at around age 50 and declines thereafter, showing a more pronounced drop for Canadian men (which, again, may be due to the particular measure used here).

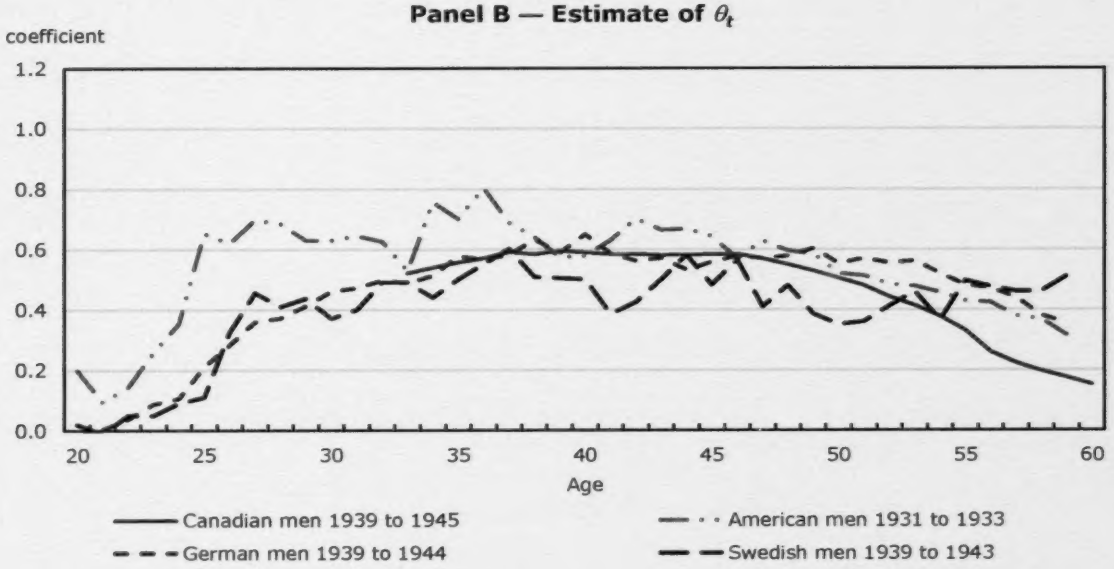
These patterns are insightful for international comparisons of the intergenerational transmission of earnings. First, even when sample and methodological differences are accounted for, cross-national variation in IGE estimates may still arise, as a result of differences in the age at which sons' earnings are observed, everything else being equal.[12] For instance, using sons' earnings corresponding to the ages from the mid-forties to the mid-fifties tends to induce an attenuation bias in the United States, but an amplification bias in the other three countries. On the other hand, lifecycle bias seems to be greatly reduced when sons' earnings are measured around the age of 40 in all countries.

For the trajectory of θ_t (Panel B), all countries exhibit a similar inverted-U-shaped profile over the lifecycle. Using current earnings to proxy for lifetime earnings as the independent variable will lead to downward bias when earnings from early and late stages of the working careers are used. In all cases, the bias is smaller around the mid-career, but θ_t remains far below unity. This suggests that the bias arising from the right-hand-side measurement error cannot be eliminated completely at any stage of the working life. It is interesting to note that, since λ_t is approximately 1 for all four countries at about age 40, θ_{40} captures the attenuation bias due to classical measurement error. Again, cross-national differences in θ_t are more visible at the beginning and end of the working career.

12. Nybom and Stuhler (2011) detailed a few additional reasons related to lifecycle income profiles that make cross-country comparisons of intergenerational mobility difficult. In particular, they argued that inconsistencies may stem from the interaction of two factors: unobserved heterogeneity in income profiles (e.g., returns to schooling) and idiosyncratic deviations from average profiles that are correlated with individual and family characteristics (e.g., stochastic income shocks to consumption).

Chart 3
Cross-national comparison of λ_t and θ_t profiles for men





Sources: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database, for data from Canada; S. Haider and G. Solon, 2006, "Life-cycle Variation in the Association Between Current and Lifetime Earnings," for data from the United States; J. Brenner, 2010, "Life-cycle Variations in the Association Between Current and Lifetime Earnings: Evidence from German Natives and Guest Workers," for data from Germany; A. Böhlmark and M.J. Lindquist, 2006, "Life-cycle Variations in the Association Between Current and Lifetime Income: Replication and Extension for Sweden," for data from Sweden.

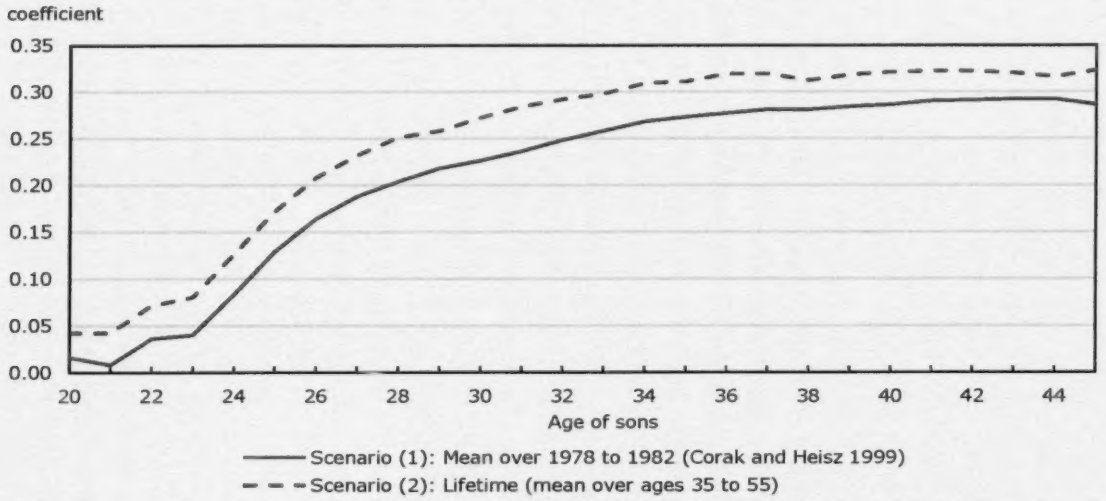
4 New evidence of intergenerational earnings and income mobility in Canada

To what extent are the estimates of the intergenerational elasticity in Canada affected by the use of inadequate proxies for both fathers' and sons' lifetime earnings? To answer this question, two different scenarios using alternative measures of fathers' lifetime earnings are presented in this part of the analysis. To compare the results from this study to previous findings, the first scenario follows Corak and Heisz (1999) and defines fathers' earnings as five-year averages over the period from 1978 to 1982.

The solid line in Chart 4 presents estimates of the IGE obtained by running an OLS regression defined by scenario 1 for different ages for which sons' earnings are observed. Overall, the estimated IGE follows a concave trajectory, reflecting lifecycle differences in the magnitude of the bias from left-hand-side measurement error. When sons' earnings are observed at around age 30, as in Corak and Heisz (1999), the model produces an estimate of β (IGE) that is nearly identical to the one in their study—about 0.227.[13] The estimated elasticity continues to increase as sons' earnings are measured at older ages. It rises to 0.29 when earnings are observed in the early forties (where λ_t approaches 1), indicating a higher degree of intergenerational earnings persistence.

13. This compares with 0.227 to 0.237 in Corak and Heisz (1999, Table 3A, specifications 3 and 4). Note that this study restricts the sample to fathers whose earnings in each of five years (1978 to 1982) are equal to or greater than $500 constant dollars. In a more recent paper, Corak, Lindquist and Mazumber (2014) pointed out that 0.250 is the preferred Canadian estimate according to an updated IID where sons' earnings are measured over the ages from 33 to 36.

Chart 4
Estimates of β (IGE) by the age of sons when earnings are observed — Two scenarios for measuring fathers' lifetime earnings



Notes: For scenario (1), lifetime earnings are calculated by averaging one's income over the years and ages indicated, conditional on having positive income ($500 and over) in at least 3 years. See footnote in Chart 1. IGE stands for intergenerational income elasticity. M. Corak and A. Heisz, 1999, "The Integenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data."

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

In addition to lifecycle bias, estimates of the IGE also depend on how fathers' lifetime earnings are calculated. Scenario 2 uses the measure for fathers' lifetime earnings introduced in this study in an attempt to minimize the right-hand-side measurement error. In general, scenario 2 (dashed line) produces higher earnings elasticity compared with the first scenario. The estimated β now increases by another 3 points, to 0.32, when sons' earnings are observed in their mid-careers. Chart 4 confirms that both left-hand- and right-hand-side measurement errors can produce a downward bias in the IGE estimates. In particular, the left-hand side lifecycle bias can be substantial when the estimated IGEs are based on sons' earnings from the very early years of their working careers.

4.1 Are Canadians as mobile as previously suggested?

Table 1 presents new estimates of the IGE for Canada. Again, different scenarios for measuring lifetime earnings of fathers and sons are offered in order to grasp the possible impact of left-hand- and right-hand-side measurement errors on the estimated coefficients. The baseline scenario (scenario 1) uses a definition of lifetime earnings similar to that used in Corak and Heisz (1999); scenario 2 mitigates left-hand-side lifecycle bias by observing sons' earnings at age 40; scenario 3 further reduces the right-hand-side attenuation bias by using fathers' earnings averaged over their prime age (from 35 to 55 years); and the last scenario—the preferred scenario in the context of this study—improves the precision of sons' lifetime earnings with the use of five-year averages around their mid-careers (i.e., ages 38 to 42). In addition to earnings, the results are presented for both market and total income (before taxes, after transfers).

With respect to scenarios 3 and 4, the father–son intergenerational earnings elasticity in Canada is about 0.32—about 46% (or 10 points) higher than the commonly quoted estimate of 0.22 from

Corak and Heisz (1999). Both sources of bias (lifecycle and errors-in-variables) contribute to the underestimation in the early studies. In general, failing to account for the lifecycle bias explains about two-thirds of the difference between the current and previous estimates, while the use of a less accurate proxy for fathers' lifetime earnings contributes to another one-third of the discrepancy. Comparing scenario 4 with scenario 3 in Table 1 also suggests that, when sons' earnings are observed at the "right" age (i.e., around their forties), replacing them by five-year averages does not significantly change the estimate of the IGE. This may suggest that there is a lesser need to approximate sons' lifetime earnings with multi-year averages as long as earnings data at their mid-careers can be observed.

Table 1
Estimates of intergenerational earnings and income elasticity, fathers and sons

Proxies for lifetime incomes	β (fathers and sons)					
	Earnings[1]		Market income[2]		Total income[3]	
	coefficient	standard error	coefficient	standard error	coefficient	standard error
Scenario 1						
Sons: at age 30						
Fathers: mean over 1978 to 1982	0.227	0.003	0.230	0.003	0.222	0.002
Scenario 2						
Sons: at age 40						
Fathers: mean over 1978 to 1982	0.287	0.004	0.301	0.003	0.317	0.003
Scenario 3						
Sons: at age 40						
Fathers: mean over ages 35 to 55[4]	0.321	0.004	0.349	0.003	0.359	0.003
Scenario 4, preferred						
Sons: mean over ages 38 to 42[5]						
Fathers: mean over ages 35 to 55[4]	0.318	0.004	0.343	0.003	0.359	0.003

1. Sum of wages and salaries from T4 Slips issued by employers, and other employment income.

2. Earnings plus self-employment and asset income.

3. Market income plus government transfers (except taxes).

4. With positive earnings or income (>=$500) in at least 10 years during ages 35 to 55.

5. With positive earnings or income (>=$500) in at least 5 years during ages 38 to 42.

Note: The number of observations for father-and-son pairs are as follows: earnings: 196,422; market income: 246,350; total income: 261,871.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

4.2 Market and total income mobility

In addition to earnings, the IID also includes other income sources that allow researchers to examine the intergenerational transmission of market as well as total income. Understanding *income* mobility can offer additional insight into transmission mechanisms across generations. Previous research, for instance, has shown clear evidence of the intergenerational transmission of jobs (Kramarz and Skans 2014), self-employment (Lentz and Laband 1990; Dunn and Holtz-Eakin 2000; Sorensen 2004), chief executive officer positions (Pérez-González 2006), liberal professions (Aina and Nicoletti 2013), and employers (Corak and Piraino 2011). Aside from financial transfers, these articles also emphasize the importance of other transmission mechanisms, such as transmission of human capital, networking and, in some cases, nepotism.

Dunn and Holtz-Eakin (2000), for example, pointed out that parents' own entrepreneurial experience and business success has a significant effect on the propensity of becoming self-employed.

This literature suggests that intergenerational persistence should be higher for market income, since this includes self-employment and asset income. The result in Table 1 confirms this expectation. The sample here further includes father–son pairs who have positive self-employment or asset income. The intergenerational elasticity for fathers and sons now increases by another 3 points to about 0.35 in the preferred model. It is also noteworthy that estimates based on scenario 1 significantly underestimate the dynamics of market income. A possible explanation is that self-employed children may not yet have started—or may have just started—their own business when they are in their early thirties. Alternatively, or perhaps in addition to this possibility, asset income may grow faster over time for children from more affluent backgrounds. As a result, the bias arising from lifecycle variation can be more pronounced for market income than for earnings.

When total income is considered, which also includes government transfers (except taxes), measuring the extent of intergenerational transmission of economic well-being in Canada becomes one step closer to reality. Individuals, both fathers and children, who are less attached to the labour market are now included in the analysis, as long as they have received transfers from governments at any level (i.e., local or national). The literature has shown a strong intergenerational correlation with the receipt of government assistance (Corak, Gustaffsson and Österberg 2004; Page 2004). If children of low-income fathers are more likely to receive government assistance, this may be reflected in the IGE estimates. However, the finding for total income of Table 1 indicates that the intergenerational persistence is only marginally higher, now being close to 0.36.

To sum up, the findings presented in Table 1 show that measuring earnings of both fathers and sons in a way that minimizes the impact of transitory earnings and lifecycle bias leads to an estimated IGE for Canada of about 0.32. The elasticity is even higher when market and total income are considered. It is important to emphasize that, while this new finding would put Canada in the middle of the international spectrum of IGE estimates (Björklund and Jäntti 2010; Corak 2013; Solon 2002), very few countries have data that allow an analysis similar to the one presented here. Probably the estimates most comparable to the coefficients presented in this paper are the results in Mazumder (2005). He reported an estimated IGE just above 0.6 in the United States when applying sample restrictions similar to the ones used here. Compared to Mazumder's results, the estimates in this study confirm that Canada remains significantly more mobile than the United States. However, the "true" rate of intergenerational transmission may not be as low as previously thought.

4.3 Gender differences in intergenerational income mobility

Table 2 replicates the analysis using father–daughter pairs. In general, the intergenerational transmission of earnings and income is weaker for daughters than for sons. The estimated elasticity is about 0.23 for earnings and between 0.24 and 0.25 for income. This result seems to suggest that daughters' outcomes are less dependent on the earnings and income of their fathers. The results from the baseline scenario (scenario 1) can be compared with those of early Canadian studies (Fortin and Lefebvre 1998; Corak 2001), which also found the intergenerational elasticities of earnings and income for fathers and daughters to be about 0.2. Interestingly, unlike the father–son IGE, the father–daughter IGE does not seem to be affected by lifecycle variation. In

fact, estimates based on daughters' earnings at age 30 (scenario 1) are very similar to those based on daughters' earnings at age 40 (scenario 2).

While this may appear puzzling at first, several factors could help explain this result. Typically, women are more likely than men to experience career breaks related to child-bearing and child rearing during the early stages of their working life. More generally, women are less attached to the labour market than men. The findings are also consistent with results from other countries regarding the role of "assortative mating," which has been identified in the literature as one of the possible reasons for lower IGEs for daughters (see Chadwick and Solon 2002; Ermisch, Francesconi and Siedler 2005; and Raaum et al. 2007). In the presence of marital sorting, daughters with high earnings potential are more likely to marry high-earnings husbands. Such daughters could choose to work fewer hours or accept lower pay in exchange for better work–family balance. In the presence of assortative mating, fathers' lifetime earnings may be more closely tied to the daughters' *family* (including spousal) earnings than to their own earnings.

This could help explain why the estimated father–daughter IGE does not rise as much as it does for sons, when earnings are measured in their forties. Although the estimates in scenario 1 may be biased downward as a result of lifecycle variation, they may be less affected by assortative mating as many daughters remain as single at age 30. On the other hand, at age 40 many daughters are already married. Consequently, low estimated coefficients in scenario 2 point to the possibility that assortative mating may be playing a role in the intergenerational transmission of income between fathers and daughters in Canada. They also suggest that future studies that focus on the extent of intergenerational transmission of income for daughters may need to consider *family* income.

Table 2
Estimates of intergenerational earnings and income elasticity, fathers and daughters

Proxies for lifetime incomes	β (fathers and daughters)					
	Earnings[1]		Market income[2]		Total income[3]	
	coefficient	standard error	coefficient	standard error	coefficient	standard error
Scenario 1						
Daughters: at age 30						
Fathers: mean over 1978 to 1982	0.191	0.004	0.212	0.003	0.213	0.003
Scenario 2						
Daughters: at age 40						
Fathers: mean over 1978 to 1982	0.195	0.004	0.207	0.004	0.222	0.003
Scenario 3						
Daughters: at age 40						
Fathers: mean over ages 35 to 55[4]	0.221	0.005	0.234	0.005	0.249	0.004
Scenario 4, preferred model						
Daughters: mean over ages 38 to 42[5]						
Fathers: mean over ages 35 to 55[4]	0.228	0.004	0.241	0.004	0.254	0.003

1. Sum of wages and salaries from T4 Slips issued by employers, and other employment income.

2. Earnings plus self-employment and asset income.

3. Market income plus government transfers (except taxes).

4. With positive earnings or income (>=$500) in at least 10 years during ages 35 to 55.

5. With positive earnings or income (>=$500) in at least 5 years during ages 38 to 42.

Note: The number of observations for father-and-daughter pairs are as follows: earnings: 160,462; market income: 205,921; total income: 216,214.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

5 Nonlinearities

The results from the linear regression analysis above may mask nonlinear patterns in the intergenerational transmission of earnings. Various hypotheses have been put forward to explain nonlinearities in the relationship between fathers' and sons' log earnings. For instance, the human capital model proposed by Becker and Tomes (1986) implies a concave pattern of intergenerational earnings transmission, as families at the bottom of the earnings distribution may be more likely to be borrowing-constrained. Empirical evidence related to this hypothesis, however, is rather mixed. In fact, studies of the Nordic European countries find instead a pattern of convexity. Bratsberg et al. (2007), for instance, showed that intergenerational earnings persistence in the Nordic countries is highly nonlinear, with greater mobility found at the bottom of the distribution. Similarly, Björklund, Roine and Waldenström (2012) reported a very high intergenerational persistence of top incomes in Sweden with an estimated elasticity of about 0.9 compared to an average value of 0.26.

Subsection 5.1 presents results related to nonlinearities in intergenerational income persistence in Canada. The analysis in the previous section indicates that the channels of intergenerational income transmission seem to be more complicated for daughters than for sons, and may require taking spousal income into account. Therefore, the analysis below is restricted to the father–son

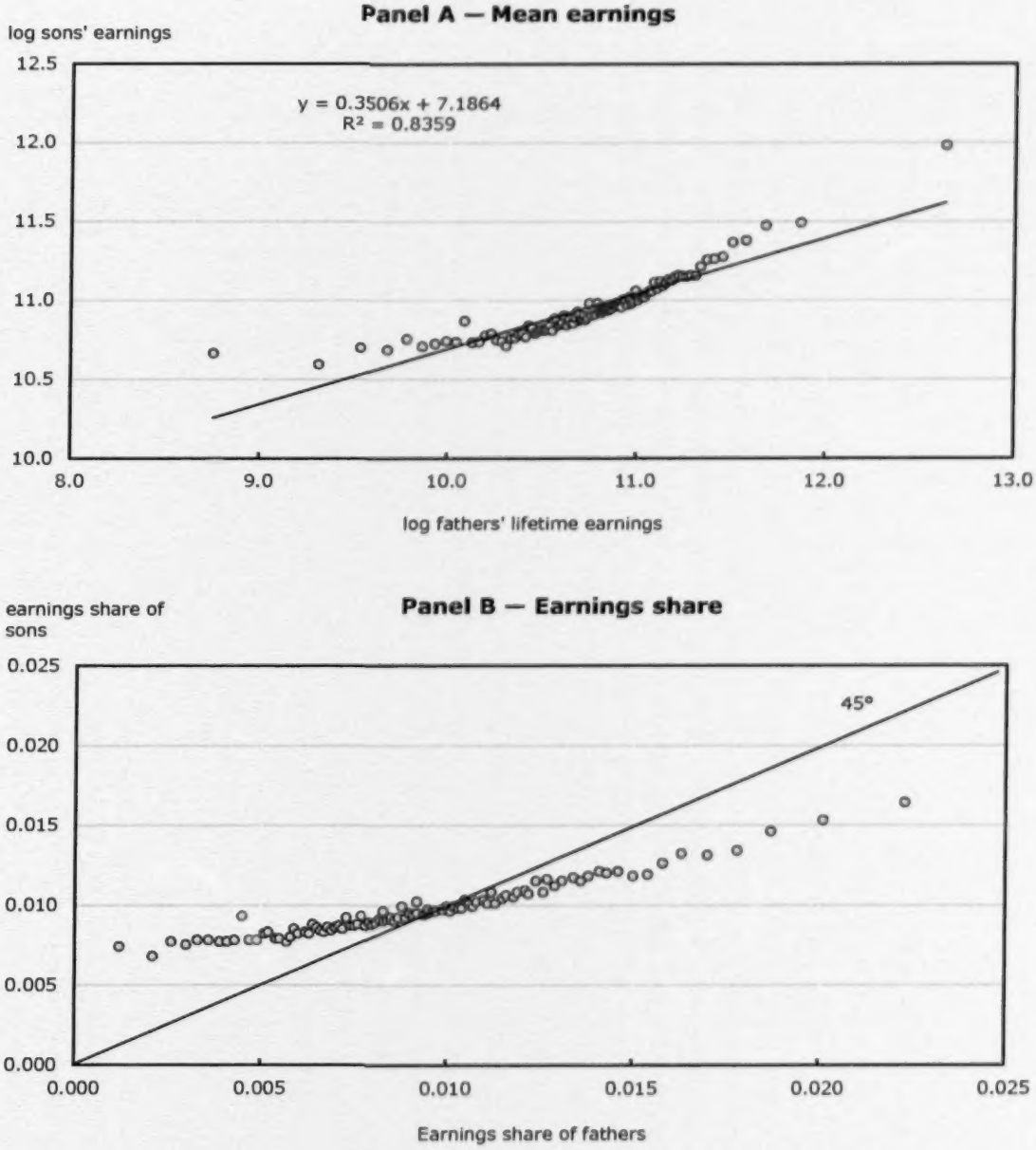
sample only. With nearly 200,000 father–son pairs in the IID, it is possible to examine potential nonlinearities at an even finer level of detail than has been done in previous Canadian studies.

5.1 Descriptive correlation

A descriptive and intuitive method well-suited to illustrating the relationship between fathers' and sons' earnings across the entire spectrum is used to examine the issue of nonlinearity. Fathers are ranked and divided into percentiles according to their lifetime earnings. This generates 100 data points for scatter plots. For each percentile of fathers' earnings, Chart 5 shows the mean log earnings (Panel A) and the earnings shares of sons and fathers (Panel B). The pattern in Panel A clearly shows that the relationship between fathers' and sons' earnings in Canada is not linear. In particular, it reveals a somewhat convex pattern. The estimated slope coefficient is 0.36, but the profile is flat at the bottom of the distribution, increases monotonically over the main part of the distribution and becomes steeper at the top. This pattern has some interesting implications. First, earnings mobility seems to be high among children born to the lowest 15 percentiles of the fathers' earnings distribution, since many of them find themselves in higher earnings percentiles than their fathers. Second, earnings persistence tends to be very high among sons born to the top 10% of the fathers' distribution, suggesting a significant degree of intergenerational transmission of advantages at the top. Third, the intergenerational earnings persistence is moderate between the 15th and 90th percentiles of the fathers' distribution.

The mean earnings in a percentile indicate little about earnings variation within the percentile. Panel (B) presents earnings shares held by sons and fathers in each percentile of the fathers' earnings distribution. If sons' lifetime earnings are independent of their fathers', one would expect earnings shares held by sons in each of the fathers' percentiles to be close to 1%. Conversely, a profile that looks like a 45-degree straight line would indicate a high degree of persistence between fathers' and sons' earnings. Panel B generally confirms the nonlinear pattern of intergenerational transmission of earnings noted earlier. Again, mobility appears to be substantial at the bottom of the distribution. For instance, the earnings share held by fathers in the lowest 1% of the distribution is only 0.1%, while the earnings share of sons from these families amount to nearly 0.8% of total sons' earnings. The correlation is stronger in the middle part of the distribution, since both sons' and fathers' earnings shares tend to move in the same direction.

Chart 5
The relationship between fathers' and sons' earnings



Note: Lifetime earnings are calculated by averaging fathers' (sons') earnings over the ages from 35 to 55 (38 to 42), conditional on having positive income of $500 and over, in at least 10 (3) years.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

The patterns of nonlinearities observed in Chart 5 do not appear consistent with the borrowing constraints model in Becker and Tomes (1986) or Mulligan (1997), which would imply a concave relationship between children's and parents' earnings. These studies suggest that parents in the lower half of the distribution are more likely to be credit-constrained. Under some additional assumptions, this would imply sub-optimal investments in children's human capital at the bottom of the fathers' earnings distribution, and thus a resulting stronger correlation (i.e., steeper profile) between father and son earnings. Credit constraints are then assumed to gradually relax at higher percentiles of the distribution; as a result, sons' earnings would become more independent from fathers' earnings in the upper half of the distribution.

A possible reason why a pattern of concavity may not be found in the data is the violation of some of the model's assumptions. Han and Mulligan (2001), for instance, showed that heterogeneity in children's innate earnings potential, as well as in parents' altruism, make testing for the existence of credit-constrained families difficult. The pattern of nonlinearity observed in the Canadian data, however, seems to be more in line with the Nordic evidence of a convex intergenerational earnings relationship. Bratsberg et al. (2007) argued that institutional factors may explain why mobility is higher at the bottom. In particular, they suggested that educational and welfare systems in Nordic countries help the upward mobility of young people with few parental resources. Interestingly, the findings of this study for Canada are different from the patterns estimated in the United States, which exhibit an almost perfectly linear relationship between children's and parents' ranks in the income distribution (Chetty et al. 2014).[14]

In sum, the nonlinear patterns in Chart 5 suggest that a single IGE coefficient may be insufficient to offer an accurate picture of intergenerational earnings mobility in Canada. Corak and Heisz (1999) reached a similar conclusion using income transition matrices and then proceeded to employ a nonparametric technique to explore the nature of these nonlinearities. In what follows, two different parametric approaches are used instead—that is, higher-order polynomial and quantile regressions—to address the issue of nonlinearities. The parametric results from this study will be briefly compared to the findings of Corak and Heisz (1999) in the last section of this paper.

5.2 Nonlinear regressions: higher-order polynomial

As shown by Bratsberg et al. (2007), more flexible functional forms (i.e., higher-order polynomial) can be used to estimate the intergenerational earnings model in order to fit the data. Here, the coefficients from a fourth-order polynomial are estimated on the IID data and used to calculate the IGE at each percentile of the fathers' earnings distribution. The results, presented in Chart 6, confirm that the degree of intergenerational earnings mobility in Canada is characterized by a marked nonlinear pattern. In fact, Chart 6 shows a logarithmic growth trajectory. In particular, the elasticity is quite low for sons at the bottom two percentiles of the fathers' earnings distribution (about 0.1); this suggests a significant degree of upward mobility for sons born to very low-earnings fathers.

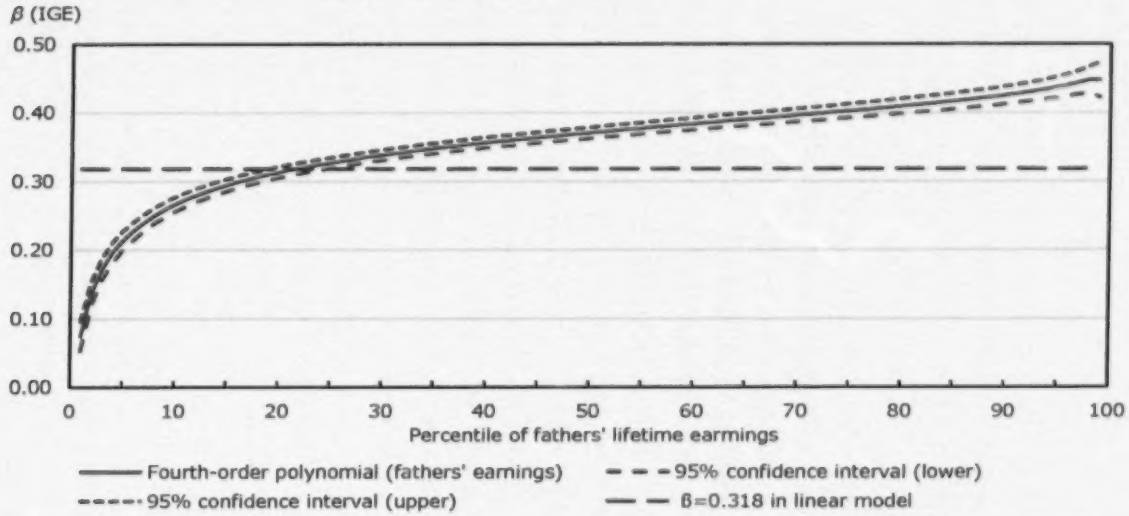
Further up the fathers' earnings distribution, the degree of mobility starts to decline. The estimated IGE sharply rises, reaching 0.32—the same value as the estimated coefficient from the linear specification—at about the 23rd percentile. Thereafter, earnings persistence increases monotonically with fathers' earnings. The estimated elasticity tops at 0.45 for the 98th and 99th

14. In addition to linearity of the rank–rank relationship in the income distribution, Chetty et al. (2014) also showed that the relationship between college attendance rates and parent income ranks is approximately linear. The latter finding would imply that all families are, to some extent, credit-constrained, as the chance of attending college increases with parental incomes at a similar rate throughout the income distribution.

percentiles of fathers' earnings, suggesting a strong intergenerational correlation of earnings among very high-earnings families.

A salient feature of Chart 6 is that the estimates from the linear model (0.32) seem to understate the intergenerational transmission of earnings for the bulk of the population. These results support the conclusions in Bratsberg et al. (2007) that international comparisons of intergenerational earnings mobility based on more flexible specifications may be more meaningful. Indeed, comparing the results in this study with the findings in Bratsberg et al. suggests that Canada has a pattern of intergenerational earnings mobility that is quite similar to the one observed in the Scandinavian countries: a flat intergenerational relationship in the lower segments of the fathers' distribution and an increasingly positive correlation in middle and upper segments. Interestingly, this pattern is not observed in the United States or in the United Kingdom (Bratsberg et al. 2007).

Chart 6
Fourth-order polynomial estimate of β (IGE), evaluated at each percentile of fathers' earnings, father–son pairs



Notes: Fathers' (sons') lifetime earnings are calculated by averaging the annual earnings over the ages from 35 to 55 (38 to 42), conditional on having positive income, $500 and over, in at least 10 (3) years. IGE stands for intergenerational income elasticity.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

5.3 Quantile regressions

While the results above present evidence of nonlinearity in the IGE across the distribution of *fathers'* earnings, it is also interesting to examine whether mobility differs across the distribution of *sons'* earnings. As pointed out in Mulligan (1997) and Corak and Heisz (1999), the optimal amount of human capital investment made by fathers may also depend—positively—upon the child's ability. These authors note that the parents who are more likely to be credit-constrained are low-income parents with high-ability children. This raises the question of how the earnings of high-ability children from low-income backgrounds compare to those of their counterparts from high-income families. The answer to this question may be informative for policy discussions related to equality of opportunity in Canada. This notion refers to the existence of similar economic opportunities for children with similar abilities, regardless of their family of origin (Roemer 1998).

Grawe (2004) suggested using quantile regressions to investigate this type of question. For instance, high elasticity in the top percentiles of children's earnings distribution would suggest that high-earnings children come almost exclusively from families with high-earnings fathers. Unless one makes particular assumptions regarding the heritability of innate ability, this can be interpreted as evidence for inequality of opportunity. That is, it would suggest that high-ability children from low-earnings backgrounds have little chances to realize their full potential and become high-income earners.

Following the approach in Grawe (2004), Chart 7 presents the results from quantile regressions estimated on the father–son pairs used in this study. The estimates are produced for each percentile (1st, 2nd..., 99th) of sons' earnings. The estimated 95% confidence intervals are also reported. The quantile regression results depict a clear pattern of nonlinearity over the distribution of sons' earnings. The estimated earnings elasticity is relatively low (about 0.2) at the bottom two percentiles of the sons' earnings distribution, rises to 0.35 at the 10th percentile, and stays at about 0.33 to 0.34 throughout the lower half of the distribution. It then drops gradually, reaching 0.27 at the 80th to the 85th percentiles, and reverses its course by rising again to 0.41 at the 99th percentile.

Three distinct patterns of intergenerational earnings transmission emerge from the quantile regression analysis. First, quantile regression coefficients are quite low for sons in the bottom two percentiles of the distribution. That is, a large fraction of sons with the lowest earnings do not have fathers who were themselves at the very bottom of the distribution in their generation. This implies that the sons of the lowest-earnings fathers are relatively mobile, which is consistent with the results from the polynomial model above. Second, from the 10th to the 85th percentiles of the distribution of the sons' earnings, persistence is fairly high in the beginning (the estimated elasticity is above 0.35 at the 10th percentile), declining slowly over the lower half, and dropping more notably over the upper-middle part of the distribution. A rather high elasticity over the lower-middle part of the sons' distribution indicates that a considerable fraction of moderate-earnings sons have fathers with similar economic outcomes. Such correlation, however, becomes less obvious as sons' earnings increase. Earnings mobility starts to rise for sons in the upper-middle part of the distribution. The estimated elasticity declines from 0.33 at the median to 0.27 at the 85th percentile. This suggests that sons from a wide range of earnings backgrounds have a good chance of becoming adults with above-average earnings. Third, Chart 7 shows the reversal of the quantile regression coefficients over the top (85th to 99th) percentiles, which reveals a stronger degree of earnings persistence for high-earnings sons. The estimated coefficients are 0.38 and 0.41 for the top two percentiles, respectively. That is, a significant fraction of those who make it to the highest-earnings groups have a high-earnings father.

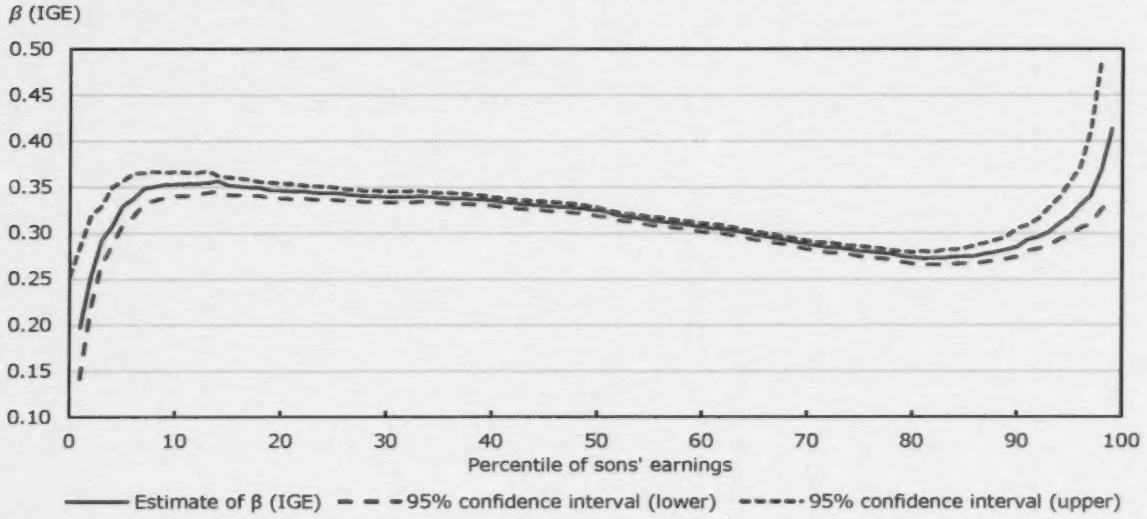
Finally, Chart 7 also suggests that Canadian earnings mobility may be characterized by rather complex transmission mechanisms. In particular, distinct channels of parental influence may be at work at different parts of the distribution. At the bottom of the distribution, institutional factors—as suggested in the Nordic studies—may play a role in facilitating upward mobility for children from very low-earnings backgrounds.[15] The estimated profile over the bulk of the distribution would be broadly in line with the credit constraints hypothesis: the relationship between moderate-earnings sons and moderate-earnings fathers is expected to be stronger because these fathers are more likely to be credit-constrained and may not be able to invest optimally in the human capital of their children. The profile corresponding to the upper-middle part of the distribution may also be consistent with less binding credit constraints for fathers whose earnings are increasingly sufficient to invest in their children's human capital. Finally, channels of transmission may be even

15. Higher mobility at the very bottom of the distribution would also be consistent with human capital models if fathers of low-ability children are reluctant to invest in the human capital of their children (Becker and Tomes 1986).

more complex at the top, as suggested in the literature. Factors other than human capital investment, such as networking or family-specific capital, may be more salient for the intergenerational earnings transmission among top-earnings families (Björklund, Roine and Waldenström 2012; Corak and Piraino 2011; Kramarz and Skans 2014).

A few caveats, however, need to be borne in mind in interpreting the dynamics at the bottom end of the distribution. It is possible that, at this end of the distribution, the mother is carrying the load in terms of market activities. Also note that the analytical sample used in this study excludes all those sons raised in fatherless (i.e., single-mother) households who are more likely to be in low-income situations. Moreover, data quality may also be a concern, since measurement error often tends to be more pronounced at the bottom end of earnings or income distribution. Further discussion on and identification of channels of influence is required, but is beyond the scope of this paper.

Chart 7
Quantile regression estimates of β (IGE), earnings of father–son pairs



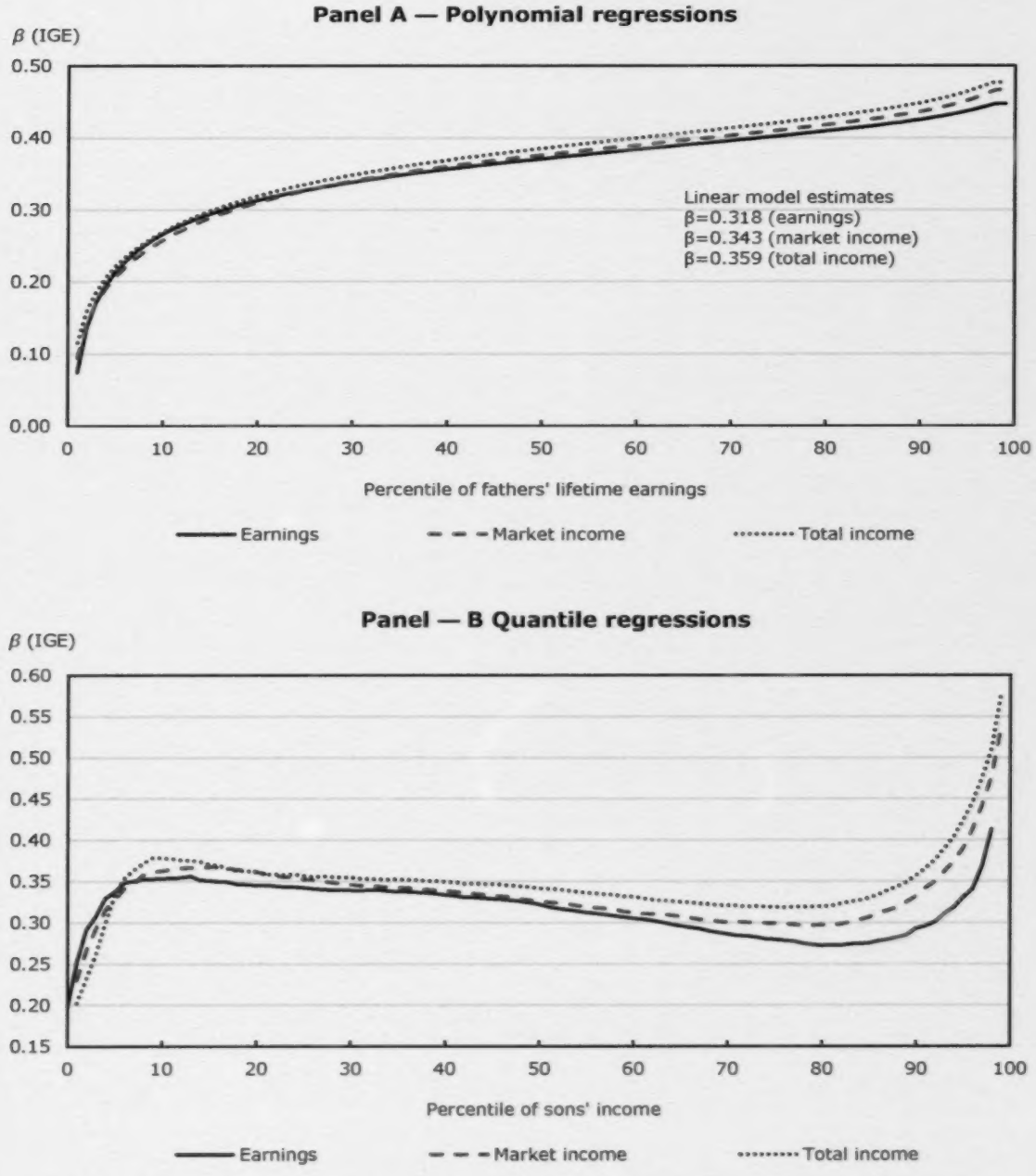
Notes: Fathers' (sons') lifetime earnings are calculated by averaging the annual earnings over the ages from 35 to 55 (38 to 42), conditional on having positive income, $500 and over, in at least 10 (3) years. IGE stands for intergenerational income elasticity.
Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

5.4 Market income and total income

Chart 8 shows nonlinear patterns in intergenerational income persistence for market (dashed line) and total (dotted line) income. Both polynomial (Panel A) and quantile (Panel B) regression results are presented. In general, despite differences in magnitude, the pattern of nonlinearity across the distribution seems quite similar for all three income measures. As in the linear model, persistence tends to be higher for market or total income than for earnings. This is especially the case at the very top: sons of fathers with the highest income are much more likely to have the highest incomes as adults.

Differences in generational persistence for different income sources, however, are more visible in the quantile regression results (Panel B). For instance, the correlation between low-income sons (e.g., those in the 10th percentile) and low-income fathers is stronger than it is between low-earnings fathers and sons. Moreover, higher mobility over the upper-middle part of the distribution is somewhat limited for market and, especially, total income. Unlike the results for earnings, where some of the higher-earnings sons (e.g., those at the 85th percentile) can come from a rather diverse earnings background, the higher-income sons are more likely to have fathers with a similar position in the income distribution. Income persistence is especially pronounced at the top end of the distribution, at 0.51 or higher for the top two percentiles of the sons' total income. These results are broadly consistent with a growing literature showing that affluent families are able to improve the income potential of their children in various ways—including better child care, private schooling, transfer of entrepreneurial skills and social connections (e.g., Duncan and Murnane 2011).

Chart 8
Nonlinear estimates of β (IGE) for fathers and sons, by income source



Notes: Fathers' (sons') lifetime earnings are calculated by averaging the annual earnings over the ages from 35 to 55 (38 to 42), conditional on having positive income, $500 and over, in at least 10 (3) years. IGE stands for intergenerational income elasticity.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

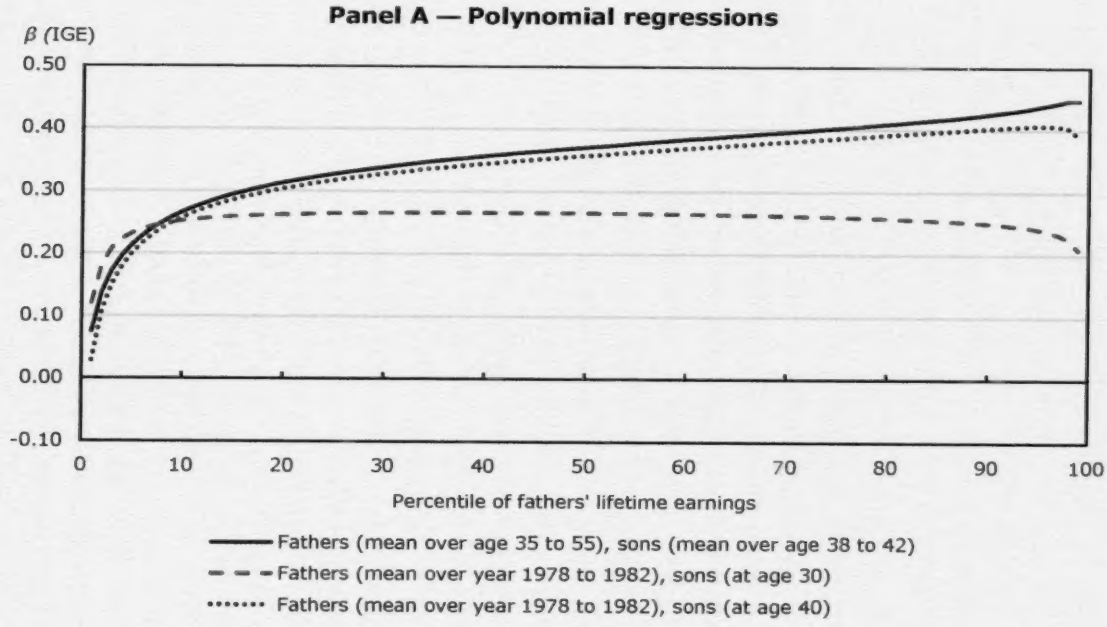
5.5 Lifecycle variation and nonlinearities

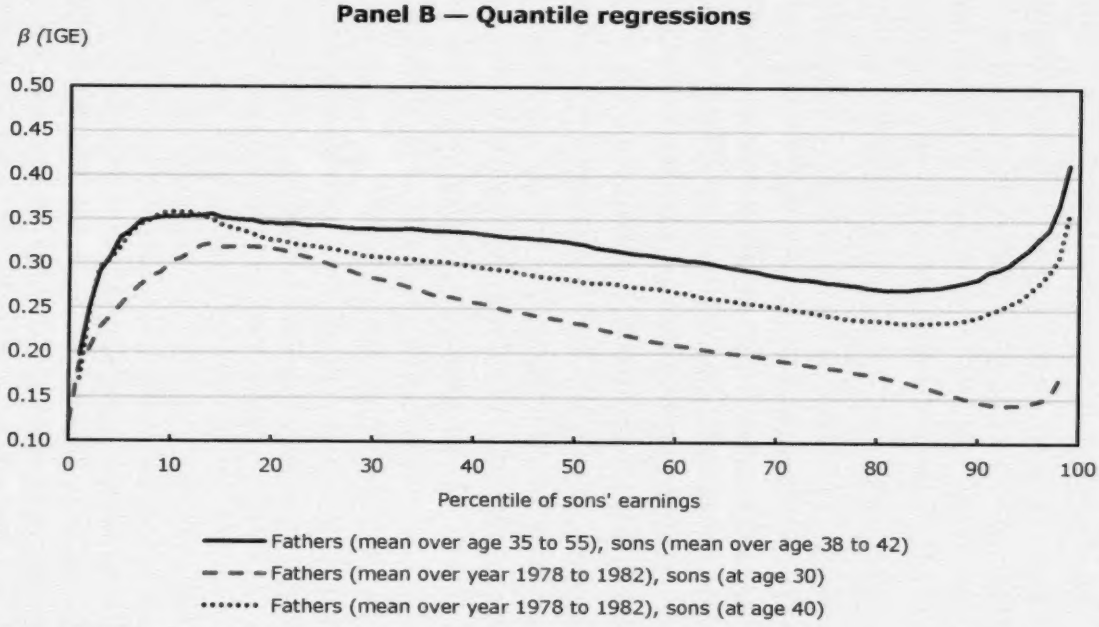
As it was the case in the simple linear model, the patterns of nonlinearity may not be estimated correctly if the lifecycle and errors-in-variables biases are not properly addressed. The distortion is likely to be greater in the upper part of the distribution, since most children with high lifetime earnings have not yet reached their full earnings potential at younger ages. To confirm this intuition, the analysis in Subsection 5.4 is repeated with two alternative definitions for fathers' and sons' lifetime earnings. The first scenario defines fathers' lifetime earnings as five-year averages over the period from 1978 to 1982, while sons' earnings are drawn from the year corresponding to age 30 (dashed line). The second scenario maintains the same earnings definition for fathers but measures sons' earnings at age 40 (dotted line). As the results in Subsection 5.4 indicate, both lifecycle and errors-in-variables biases are likely to be present in the first scenario, while the former bias can be minimized in the second scenario. The results are presented in Chart 9, which also provides the preferred estimates for reference (solid line).

Chart 9, indeed, reveals a very different pattern of nonlinearity when sons' earnings at age 30 are used. For polynomial regressions, this leads to an underestimation of intergenerational persistence throughout virtually the entire distribution of fathers' earnings. Because of lifecycle variation, the extent of the correlation between fathers' and sons' earnings appears to be particularly underestimated in the upper part of the distribution. For instance, the estimated elasticity at the 95th percentile is only 0.24—about 45% lower than the estimate (0.44) from the preferred definition. When lifecycle bias is minimized by using sons' earnings at age 40, the pattern of nonlinearity is almost identical to the pattern yielded by the preferred model for much of the distribution. However, the estimates for the top percentiles are still lower than those in the preferred model because the measure of fathers' earnings is less accurate.

The quantile regression results also show that not accounting for lifecycle variation may result in significantly biased patterns of nonlinearity. The decline in earnings persistence from the 15th to the 95th percentiles of sons' earnings is much steeper than that produced by the preferred model and, thus, gives a wrong impression that mobility increases until the 95th percentile of the sons' distribution. The estimated elasticity at the 95th percentile is as low as 0.14, when sons' earnings at age 30 are used as a proxy for lifetime earnings, 56% lower than the preferred estimate of 0.32. Again, the pattern of nonlinearity becomes more similar to the one from the preferred model when sons' earnings at age 40 are used. It is also interesting to note that using five-year earnings averages from a given time period for fathers also leads to a downward bias in the quantile regression estimates for large segments in the middle of the sons' earnings distribution.

Chart 9
Lifecycle variation and nonlinearities





Note: IGE stands for intergenerational income elasticity.

Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

Finally, note that Corak and Heisz (1999) also examined the nature of nonlinearities in intergenerational earnings persistence in Canada. They estimated a flexible nonparametric model on the older version of the IID data. While a direct comparison with this study is not possible as a result of the different functional forms employed, it is interesting to note that Corak and Heisz (1999) also showed a considerable rise in the estimated elasticity at the very top of the distribution—above the 99th percentile. Unlike the results from this study, however, they found less persistence just below the 99th percentile compared with the IGE estimated for most of the upper part of the distribution. It is difficult to say whether this difference stems from the different functional forms employed in the two studies, or from the improved dataset used in this study, which better accounts for lifecycle variation in earnings. However, the results depicted in Chart 9 suggest that inaccurate proxies for lifetime earnings can significantly distort the estimated patterns of nonlinearity in the intergenerational transmission of earnings.

6 Conclusion

Understanding the extent of intergenerational earnings and income mobility is informative for economic and social policy. In particular, estimates of intergenerational income elasticity (IGE) are often seen as broad indicators of equality of opportunity. However, because full career histories of parents and children are generally not available in the data, many existing IGE estimates for various countries may be affected by biases arising from inadequate proxies for lifetime earnings. This paper re-examines the extent to which lifecycle variation and errors-in-variables can bias IGE estimates, both at the mean of and across the percentiles of the income distribution. It is expected that the new augmented Intergenerational Income Database from Canada, with nearly full history of career data, will serve to advance understanding of this subject.

The analysis shows that lifecycle bias may be present at any stage of the working career. The bias tends to be higher when annual earnings from early career years are used to proxy for lifetime earnings as the dependent variable. This finding is in line with the existing international evidence. However, the study also identified cross-country differences with respect to the age at which lifecycle bias may be minimal. This finding highlights the difficulty in making appropriate international comparisons, even when accounting for the sample and methodological differences. That is, cross-national variation in IGE estimates may still arise, as a result of differences in the age at which sons' earnings are observed.

The intergenerational earnings elasticity for Canada is estimated at about 0.32. This is higher than the approximate 0.2 estimate obtained in Canadian literature. Accounting for lifecycle bias in the early estimates explains about two-thirds of the discrepancy, while errors-in-variables-induced bias contributes to the remaining difference. The study shows that the extent of the bias is larger for market and total income than for earnings alone. The results also reveal significant gender differences with regard to the effect of these biases on the estimated IGEs. The father–daughter elasticity remains quite modest irrespective of the ages at which daughters' earnings are measured. The lower IGE for daughters may be driven by gender differences in labour force participation and/or by estimation issues related to marital sorting. This highlights the need for a closer look into these patterns for future research.

Using data less affected by measurement error compared with those used in previous studies, this paper explains a distinct pattern of nonlinearity in the intergenerational transmission of income in Canada. The results indicate that the relationship between fathers' and sons' earnings exhibits a rather convex pattern; one that is similar to that found in Nordic European studies, but that is in contrast to the linear pattern observed in the U.S. literature. Both polynomial and quantile regressions reveal high mobility rates at the very bottom of the distribution and low mobility at the top. One possible conjecture is that social institutions may help explain these findings. Moreover, the study demonstrates that the patterns of nonlinearity can be significantly misread when the lifecycle and errors-in-variables biases are not adequately addressed, especially over the upper part of the distribution.

Appendix

Appendix Table 1
Age distribution of fathers in 1978, Intergenerational Income Database

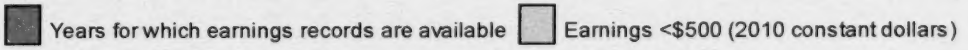
Age in 1978	Distribution		Mean earnings over 1978 to 1982
	number	percent	2010 constant dollars
34 years of age or less	27,001	5.34	46,557
35 to 40 years of age	137,263	27.13	53,509
41 to 45 years of age	143,230	28.31	55,282
46 to 50 years of age	108,582	21.46	54,202
51 years of age and older	89,910	17.77	49,252
Total	**505,986**	**100.00**	**53,155**

Notes: Sample includes all fathers (of sons and daughters) associated with IID cohort of 1982. The sum of the figures may not correspond to the totals shown because of rounding.
Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database (IID).

Appendix Table 2

Illustration of sample section criteria for fathers — Linked earnings years for fathers, 1978 to 1999

Name	Father's birth cohort	Father aged 35	Father aged 55	Age of father (years) 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	Number of records from age 35 to 55	Number of records with earnings >=$500	Records used
A	1925	1960	1980		3	3	No
B	1935	1970	1990		13	13	Yes
C	1940	1975	1995		18	16	Yes
D	1943	1978	1998		21	21	Yes
E	1944	1979	1999		21	15	Yes
F	1950	1985	2005		15	15	Yes
G	1950	1985	2005		15	7	No
H	1955	1990	2010		10	10	Yes
I	1960	1995	2015		5	5	No



Source: Statistics Canada, authors' calculations based on data from the Intergenerational Income Database.

References

Aina, C., and C. Nicoletti. 2013. *The intergenerational transmission of liberal professions: nepotism versus abilities*. Unpublished mimeo.

Baker, M., and G. Solon. 2003. "Earnings Dynamics and Inequality among Canadian Men, 1976-1992: Evidence from Longitudinal Income Tax Records." *Journal of Labor Economics* 21 (2): 289–321.

Becker, G.S., and N. Tomes. 1986. "Human Capital and the Rise and Fall of Families." *Journal of Labor Economics* 4 (3): S1–S39.

Björklund, A. 1993. "A Comparison between Actual Distributions of Annual and Lifetime Income: Sweden 1951-89." *Review of Income and Wealth* 39 (4): 377–386.

Björklund, A., and M. Jäntti. 2010. "Intergenerational Income Mobility and the Role of Family Background." In *Oxford Handbook of Economic Inequality*, ed. W. Salverda, B. Nolan, and T. Smeeding. Oxford: Oxford University Press.

Björklund, A., J. Roine, and D. Waldenström. 2012. "Intergenerational top income mobility in Sweden: Capitalistic dynasties in the land of equal opportunity?" *Journal of Public Economics* 96 (5-6): 474–484.

Böhlmark, A., and M.J. Lindquist. 2006. "Life-Cycle Variations in the Association between Current and Lifetime Income: Replication and Extension for Sweden." *Journal of Labor Economics* 24 (4): 879–900.

Bratsberg, B., K. Røed, O. Raaum, R. Naylor, M. Jäntti, T. Eriksson, and E. Österbacka. 2007. "Nonlinearities in Intergenerational Earnings Mobility: Consequences for Cross-Country Comparisons." *The Economic Journal* 117: C72–C92.

Brenner, J. 2010. "Life-Cycle Variations in the Association between Current and Lifetime Earnings: Evidence for German Natives and Guest Workers." *Labour Economics* 17 (2): 392–406.

Chadwick, L., and G. Solon. 2002. "Intergenerational Income Mobility among Daughters." *The American Economic Review* 92 (1): 335–344.

Chetty, R., N. Hendren, P. Kline, and E. Saez. 2014. "Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States." *The Quarterly Journal of Economics* 129 (4): 1553–1623.

Corak, M. 2001. "Are the Kids All Right? Intergenerational Mobility and Child Well-Being in Canada." In *Review of Economic Performance and Social Progress*, ed. K. Banting, A. Sharpe and F. St-Hilaire, p. 273–292. Montréal and Ottawa: Institute for Research on Public Policy and Centre for the Study of Living Standards.

Corak, M. 2006. "Do Poor Children Become Poor Adults? Lessons from a Cross Country Comparison of Generational Earnings Mobility." In *Research on Economic Inequality*, ed. J. Creedy and G. Kalb, vol. 13 (1), p. 143–188. Amsterdam: Elsevier B.V.

Corak, M. 2013. *Income Inequality, Equality of Opportunity, and Intergenerational Mobility*. IZA Discussion Paper No. 7520. Bonn: The Institute for the Study of Labor (IZA).

Corak, M., B. Gustafsson, and T. Österberg. 2004. "Intergenerational Influences on the Receipt of Unemployment Insurance in Canada and Sweden." In *Generational income mobility in North America and Europe*, ed. M. Corak. Cambridge, U.K.: Cambridge University Press.

Corak, M., and A. Heisz. 1999. "The Intergenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data." *The Journal of Human Resources* 34 (3): 504–533.

Corak, M., M. Lindquist, and B. Mazumder. 2014. "A Comparison of Upward and Downward Intergenerational Mobility in Canada, Sweden and the United States." *Labour Economics* 30 (C): 185–200.

Corak, M., and P. Piraino. 2011. "The Intergenerational Transmission of Employers." *Journal of Labor Economics* 29 (1): 37–68.

Duncan, G.J., and R.J. Murnane. 2011. "Introduction: The American Dream, Then and Now." In *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances*, ed. G.J. Duncan and R.J. Murnane. New York: Russell Sage Foundation.

Dunn, T., and D. Holtz-Eakin. 2000. "Financial Capital, Human Capital, and the Transition to Self-Employment: Evidence from Intergenerational Links." *Journal of Labor Economics* 18 (2): 282–305.

Ermisch, J., M. Francesconi, and T. Siedler. 2005. *Intergenerational Economic Mobility and Assortative Mating*. Discussion Paper No. 1847. Bonn: The Institute for the Study of Labor (IZA).

Fortin, N., and S. Lefebvre. 1998. "Intergenerational Income Mobility in Canada." In *Labour Markets, Social Institutions, and the Future of Canada's Children,* ed. M. Corak. Statistics Canada Catalogue no. 89-553-X. Ottawa: Statistics Canada.

Gouskova, E., N. Chiteji, and F. Stafford. 2010. "Estimating the intergenerational persistence of lifetime earnings with life course matching: Evidence from the PSID." *Labour Economics* 17 (3): 592–597.

Grawe, N.D. 2004. "Reconsidering the Use of Nonlinearities in Intergenerational Earnings Mobility as a Test for Credit Constraints." *Journal of Human Resources* 39 (3): 813–827.

Grawe, N.D. 2006. "Lifecycle bias in estimates of intergenerational earnings persistence." *Labour Economics* 13 (5): 551–570.

Haider, S., and G. Solon. 2006. "Life-Cycle Variation in the Association between Current and Lifetime Earnings." *The American Economic Review* 96 (4): 1308–1320.

Han, S., and C.B. Mulligan. 2001. "Human Capital, Heterogeneity and Estimated Degree of Intergenerational Mobility." *The Economic Journal* 111 (470): 207–243.

Kramarz, F., and O.N. Skans. 2014. "When Strong Ties are Strong: Networks and Youth Labour Market Entry." *The Review of Economic Studies* 81: 1164–1200.

Lentz, B.F., and D.N. Laband. 1990. "Entrepreneurial Success and Occupational Inheritance among Proprietors." *Canadian Journal of Economics* 23 (3): 563–579.

Mazumder, B. 2005. "Fortunate Sons: New Estimates of Intergenerational Mobility in the United States Using Social Security Earnings Data." *The Review of Economics and Statistics* 87 (2): 235–255.

Mulligan, C.B. 1997. *Parental Priorities and Economic Inequality*. Chicago: University of Chicago Press.

Nybom, M., and J. Stuhler. 2011. "Heterogeneous Income Profiles and Life-Cycle Bias in Intergenerational Mobility Estimation." Discussion Paper No. 5697. Bonn: The Institute for the Study of Labor (IZA).

Oreopoulos, P. 2003. "The long-run consequences of growing up in a poor neighborhood." *Quarterly Journal of Economics* 118: 1533–1575.

Oreopoulos, P., M. Page, and A.H. Stevens. 2008. "The intergenerational effects of worker displacement." *Journal of Labor Economics* 26: 455–484.

Page, M.E. 2004. "New Evidence on Intergenerational Correlations in Welfare Participation." In *Generational income mobility in North America and Europe*, ed. M. Corak. Cambridge, U.K.: Cambridge University Press.

Pérez-González, F. 2006. "Inherited Control and Firm Performance." *American Economic Review* 96 (5): 1559–1588.

Raaum, O., B. Bratsberg, K. Røed, E. Österbacka, T. Eriksson, M. Jäntti, and R.A. Naylor. 2007. "Marital sorting, household labor supply and intergenerational earnings mobility across countries." *The B.E. Journal of Economic Analysis and Policy* 7 (2): Article 7.

Roemer, J.E. 1998. *Equality of opportunity*. Cambridge, Massachusetts: Harvard University Press.

Statistics Canada. 2010. *Intergenerational Income Data Reference Manual*. Unpublished manuscript. Ottawa.

Solon, G. 1992. "Intergenerational Income Mobility in the United States." *American Economic Review* 82 (3): 393–408.

Solon, G. 1999. "Intergenerational Mobility in the Labor Market." In *Handbook of labor economics*, ed. O.C. Ashenfelter and D. Card, vol. 3A, p. 1761–1800. Amsterdam: Elsevier Science B.V.

Solon, G. 2002. "Cross-country differences in intergenerational earnings mobility." *Journal of Economic Perspectives* 16 (3): 59–66.

Sorensen, J.B. 2004. *Closure and Exposure: Mechanisms in the Intergenerational Transmission of Self-employment*. Unpublished mimeo.